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BACTERIOLOGY.

The Structure and Functions of Bacteria. By Alfred Fischer, Professor of Botany at the University of Leipzig. Translated into English by A. Coppen Jones. Pp. viii + 198. (London: Clarendon Press, 1900.)

THE first two chapters are concerned with the morphology of bacteria, and the subject is most ably dealt with, as might be expected from so talented a botanist as Prof. Fischer. Nevertheless, these are not the chapters which strike one as of exceptional interest or importance, because they treat of matters discussed in every text-book of bacteriology, and afford but little new information.

Chapters iii. and iv., under the title of "Taxonomy," deal with the question of species and variability among bacteria; the involution and attenuation of microbes; the systematic position of bacteria and their classification. Prof. Fischer points out that the heated controversy on the "species question" rests on our different conception of *pleogony* and *pleomorphism* among bacteria. Pleomorphism in its true sense does not exist among bacteria according to Fischer, and mutability of function (other than of a temporary character) is also denied by him. Thus he asserts positively that "It has not been hitherto possible to entirely suppress a single biological character in any species." We are inclined to take a less dogmatic position as regards the *suppression* of a biological character, while fully agreeing with the author that the attainment in our cultures of *acquired* characters that are permanent and hereditary in bacteria is not to be expected. The classification of bacteria proposed by Fischer has much to commend it, but it is natural to shrink from so sweeping a change in our existing nomenclature as would be necessary if his views were universally adopted. The tetanus bacillus, according to Fischer, would fall under the genus Plectridium, the sub-family Plectridiæ, the family Bacillaceæ, and the order Haplobacterinæ. The typhoid bacillus would come under the same order, but the genus would be Bactridium, the sub-family Bacilleæ, and the family Bacillaceæ.

Fischer suggests that

"the names of the genera might be formed conveniently in such a way that the root of the word indicated the shape of the cell, and the termination the arrangement of the cilia. The root-words might be *baktron* (rod), *kloster* (spindle), and *plectron* (drum-stick), and the terminations *-inium* for monotrichous, *-illum* for loptotrichous, and *-idium* for peritrichous types."

Chapter v. deals with the distribution of bacteria; their modes of life, and spontaneous generation. Using the modes of nutrition as a basis for classification, Fischer divides bacteria into the following groups:—

I. *Prototrophic Bacteria.*

Nitrifying bacteria, bacteria of root-nodules, sulphur and iron bacteria, occur only in the open in nature—never parasitic, always monotrophic.

II. *Metatrophic Bacteria.*

Zymogenic, saprogenic and saphrophile bacteria occur in the open and upon the external and internal surfaces of the body—sometimes parasitic (facultative parasites), monotrophic or polytrophic.

III. *Paratrophic Bacteria.*

Occur only in the tissues and vessels of living organisms—true (obligatory) parasites.

The author remarks that it is worthy of note that not only the bacteria but all other organisms can be arranged in these three biological divisions.

Chapters vi. to ix deal with the physiology of nutrition, general principles of culture, respiration of bacteria, influence of physical agents, and the action of chemicals. It is impossible in the limits of this review to do justice to these chapters, which although treating of matters described in every text-book of bacteriology, yet succeed in presenting the subject to the reader in a new and attractive light.

Chapters x. and xi. treat of the circulation of nitrogen in nature. It may be said without fear of contradiction that the author has dealt with this complex problem in a masterly manner. No other writer that we are aware of (unless, perhaps, Lafar) has placed the subject before the reader in so comprehensive and intelligible a form. To indicate the scope of these chapters we cannot forbear quoting from the introductory remarks as follows:—

"Apart from the activity of organisms like the pigment and phosphorescent bacteria, and other remarkable metabolism of the sulphur—and iron—bacteria, the work of bacteria in nature embraces three great processes:

(1) The circulation of nitrogen: effected by putrefaction, the formation of nitrates, and the assimilation of atmospheric nitrogen.

(2) The circulation of carbon by the fermentation of carbohydrates and other non-nitrogenous products of animals and plants.

(3) The causation of disease in other organisms, particularly in man and the higher animals.

There are in nature five sources of nitrogen open to plants and animals:

(1) The atmosphere (79 per cent. by volume of free nitrogen).

(2) The nitrates of the soil and the traces of nitrous acid formed in the air during thunderstorms.

(3) Ammonia, which occurs in minute quantities in the air, and is set free abundantly by the putrefaction and decay of dead organisms.

(4) Animal excreta, which contains nitrogen compounds of many kinds, even down to ammonia; and

(5) The tissue of plants and animals."

Chapters xii. to xiv. deal with the circulation of carbon dioxide in nature, and they are full of interest to the biologist, and will doubtless appeal very strongly to students of agricultural chemistry.

Chapters xv. to xvii. treat of bacteria in relation to disease. In no captious spirit we venture to offer the criticism that here the author treads on less familiar ground, and although the subject is discussed in a scholarly and instructive manner, there is some evidence that a pure botanist is apt to fall into error when invading the domain of the pathologist. We do not agree with the author when he says that *B. coli* is almost indistinguishable from the parasite of typhoid fever. It is easily distinguished—the difficulty lies in differentiating between certain phase-forms or allies of *B. coli* and the typhoid germ. Again, Prof. Fischer would seem to be in error when he says that the dimensions of the two are about the same, that both are actively motile and peritrichously ciliated, and that the cilia are too delicate for their number to be of determinative value. As a

matter of fact, *B. coli* is a short rod, hardly longer than broad, frequently showing only very feeble motility, and usually having only 1 to 3 flagella, which stain with difficulty; whereas the typhoid bacillus occurs as long, thin, slender rods and filaments, which (the rods) are actively motile and move about in a fashion quite different from the colon bacillus. Moreover, the flagella average ten in number, and stain readily. The statement that *B. coli* is frequently present in dirty water must be accepted with reserve, unless it be assumed that the word "dirty" is meant by the author to convey the idea of fouling with matter of an excremental sort. Again, the author, speaking of the staphylococci (s.p. aureus, citreus and albus), says that in nature these germs are found everywhere. We venture to dispute the truth of this remark, which is stated as if it were a fact; yet in our judgment it is merely a supposition, and an erroneous one.

These few criticisms are made in no carping spirit; indeed, the book as a whole strikes us as being one of the best that has been written on the subject, and in many respects it is quite unique. The chapters dealing with the circulation of nitrogen and carbon in nature are altogether admirable. We can find no words sufficiently strong to recommend this book to the perusal of all students of bacteriology, and particularly to those interested in biology from the technical point of view.

Unstinted praise must be given to the translator; in offering to English readers a translation of Prof. Alfred Fischer's "Vorlesungen über Bakterien" he has placed us under a deep debt of gratitude. A. C. HOUSTON.

OUR BOOK SHELF.

A Walk Through the Zoological Gardens. By F. G. Aflalo, F.R.G.S., F.Z.S. Pp. 232. (London: Sands and Co., 1900.)

IT is not by any means abundantly clear that a guide to the Zoological Society's Gardens is needed, inasmuch as there already exists the well-known and accurate guide to the Society's collection by Mr. Sclater. Although it is true that the author does not call his book a "guide" in the title, he nevertheless observes in the preface that it is his object "to conduct the reader from house to house and from paddock to paddock, pointing out the chief features of interest" on the way. We must, therefore, consider the book as intended to be a guide. As such it does not appear to us to be at all informing; it would have been well, too, to avoid positive error. The author calls a sea-lion a seal, which—seeing that true seals are often exhibited—is confusing. The African Mudfish, *Protopterus*, often on view in the Reptile house, is dubbed *Lepidosiren*, which, we need scarcely explain, is a South American Dipnoan. There are other errors of fact, and certain statements which are so loose and confused that they are practically erroneous. It is naturally impossible in a small book like the present to give an exhaustive account of all the animals to be seen in the course of a year or two in the Gardens. But the author leaves out so many important beasts that he fails to convey a real notion of the extent and variety of the collection. By cutting out the tale of how he rescued a blue pencil from a cormorant, which afterwards swallowed a lady's parasol, and by forbearing to mention that porcupines "pare their teeth on elephants' tusks" (!), and generally by avoiding gossip of a totally uninteresting and equally uninstructive kind, Mr. Aflalo might have grappled more successfully with the immense amount of material at his disposal.

LETTER TO THE EDITOR.

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The Reform of Mathematical Teaching.

To your issue of August 2 Prof. Perry contributes an indictment of the present system of mathematical teaching in this country. As he invites criticism, one need not apologise either for defending existing methods or for criticising his suggested improvements. His main attack seems to be directed against mathematics as an educational subject, and in particular the teaching of Euclid falls under his ban. The elements of abstract reasoning are, he says, quite unnecessary to a boy's mental development. Why does he not add that common-sense is of no value also?

Do we always first learn by actual trial, as is stated in his article? Do we throw ourselves into deep water and learn to swim forthwith? Do we set about jumping, cycling, billiards or cards without any previous explanation? Surely, as a rule, in these matters we are taught, not only what to do at the start, but also, if we can grasp them, the guiding principles. In a game of whist, who does not dread the unreasoning partner who has learnt the rule "Third player plays highest," and blindly acts upon it?"

Euclid, though it might advantageously be shortened by the assumption of a few more axioms and postulates, is not, I venture to say, at all a "soul-destroying, weary, worrying study for the schoolboy." Of course it may be made so, but to every boy, with care, it may become interesting, and, in the experience of many teachers, it proves a more engrossing subject to their classes than either arithmetic or algebra.

Prof. Perry very properly points out some of the weak spots in present-day arithmetic. He instances "our abominable system of weights and measures." One may suggest that that system is hardly the fault of our system of mathematics; it is entirely its misfortune. Will he not, instead of girding at the unfortunate teachers of mathematics, agitate for a conference of delegates from all bodies interested in this most important question?

Later on in his article it is stated that practice, interest, discount, tare and tret, alligation, position, &c., are at this day taught exactly as during the last century. This statement is absurd.

It is true that discount, percentages, stocks, areas, &c., are all dependent on the rule of proportion; but for purposes of explanation and of interest it is certainly as well not to lump these together in one heterogeneous muddle under the head of "Proportion." If such a method were in vogue, or if the whole of arithmetic were, by means of formulæ, reduced to multiplication and division, one would certainly see "the film of dulness covering a boy's face as he entered the class-room."

As regards the syllabus quoted by Prof. Perry, it is easy to agree with him thus far—that it is admirably adapted for a *technical* training. In practical mathematics, where mental training is of minor importance, exigencies of time will compel the teacher to omit explanations, or only to give them roughly, for his chief object is to enable his pupils to apply mathematical results, as distinct from reasoning, to problems in engineering, science, or kindred subjects.

On the other hand, the average boy's mathematical education up to the age of fifteen or sixteen is an absolutely different matter; to put it crudely—the teacher's main effort is to enable his pupil to ask and to answer reasonably the question "Why?"

At present there is really no orthodox system, but, in my opinion, the methods enunciated in the principal text-books of the day do, with slight exceptions, tend to develop a boy's mental powers.

When the boy has decided on his profession, then by all means continue his education on the lines suggested by Prof. Perry.

Finally (if one may misquote his opening words), "it is very important to try to get a view of our system of teaching mathematics, which is not too much tinted with pleasant (or possibly unpleasant) memories of science and engineering."

W. F. BEARD.